EXAMPLE 1 ➤ Plot the graph of $f(x) = -x^2 + 5x + 3$ in the domain $0 \le x \le 4$. What kind of function is this? Give the range. Find a pair of real-world variables that could have a relationship described by a graph of this shape.

SOLUTION Enter the equation with restricted domain into your grapher directly. Or, to use Boolean variables, enter

$$f_1(x) = -x^2 + 5x + 3 \,/\, (x \ge 0 \text{ and } x \le 4)$$

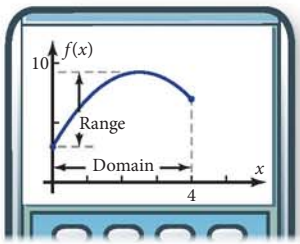

Figure 1-2k

The graph in Figure 1-2k shows the restricted domain.

The function is quadratic because $f(x)$ equals a second-degree polynomial in x.

The range is $3 \le f(x) \le 9.25$. You can find this interval by tracing to the left endpoint of the graph where $f(0) = 3$ and to the high point where $f(2.5) = 9.25$. (At the right endpoint, $f(4) = 7$, which is between 3 and 9.25.)

The function could represent the relationship between something that rises for a while and then falls, such as a punted football's height as a function of time or (if $f(x)$ is multiplied by 10) the grade you could get on a test as a function of the number of hours you study for it. (The grade could be lower for longer times if you stay up too late and thus are sleepy during the test.) ◄

DEFINITION: Boolean Variables

A **Boolean variable** is a variable that has a given condition attached to it. If the condition is true, the variable equals 1. If the condition is false, the variable equals 0.

EXAMPLE 2 ➤ As children grow older, their height and weight are related. Sketch a reasonable graph to show this relation and then describe it. Identify what kind of function has a graph like the one you drew.

SOLUTION Weight depends on height, so weight is on the vertical axis, as shown on the graph in Figure 1-2l. The graph curves upward because doubling the height more than doubles the weight. Extending the graph sends it through the origin, but the domain starts beyond the origin at a value greater than zero, because a person never has zero height or weight. The graph stops at the person's adult height and weight. A power function has a graph like this.

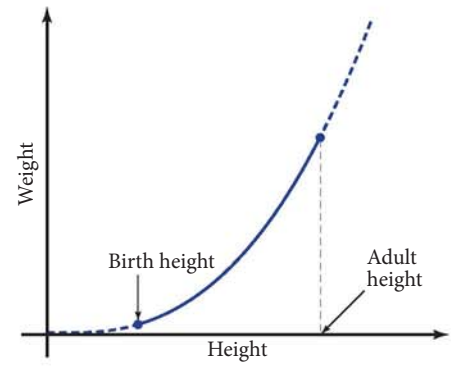

Figure 1-2l

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